PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF A GRADUATE COURSE
(500-800 LEVEL)

DEPARTMENT Mechanical Engineering
EFFECTIVE SESSION Spring 2017

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

1. New course with supporting documents (complete proposal form)
2. Add existing course offered at another campus
3. Expiration of a course
4. Change in course number
5. Change in course title
6. Change in course credit/type
7. Change in course attributes
8. Change in instructional hours
9. Change in course description
10. Change in course requisites
11. Change in semesters offered
12. Transfer from one department to another

PROPOSED:

<table>
<thead>
<tr>
<th>Subject Abbreviation</th>
<th>Course Number</th>
<th>Long Title</th>
<th>Short Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>65000</td>
<td>Computational Fracture Mechanics</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

CREDIT TYPE

<table>
<thead>
<tr>
<th>1. Fixed Credit: Cr. Hrs.</th>
<th>2. Variable Credit Range: Minimum Cr. Hrs. (Check One) To Or Maximum Cr. Hrs.</th>
<th>3. Equivalent Credit: Yes</th>
<th>4. Thesis Credit: Yes</th>
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</thead>
</table>

COURSE ATTRIBUTES: Check All That Apply

- 1. Pass/Not Pass Only
- 2. Satisfactory/Unsatisfactory Only
- 3. Repeatable
- 4. Credit by Examination
- 5. Designator Required
- 6. Special Fees
- 7. Registration Approval Type: Instructor
- 8. Variable Title
- 9. Remedial
- 10. Honors
- 11. Full Time Privilege
- 12. Off Campus Experience

INSTRUCTIONAL TYPE

- Lecture
- Recitation
- Presentation
- Laboratory
- Lab Prep
- Studio
- Distance
- Clinic
- Experiential
- Research
- Ind. Study
- Prac/Observ

<table>
<thead>
<tr>
<th>Minutes Per Mtg</th>
<th>Meetings Per Week</th>
<th>Weeks Offered</th>
<th>% of Credit Allocated</th>
<th>Delivery Method</th>
<th>Delivery Medium (Audio, Internet, Live, Text-Based, Video)</th>
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COURSE DESCRIPTION (INCLUDE REQUISITES):

Calumet Department Head Date
Calumet School Dean Date
Calumet Undergrad Curriculum Committee Date

Fort Wayne Department Head Date
Fort Wayne School Dean Date
Fort Wayne Chancellor Date

Indianapolis Department Head Date
Indianapolis School Dean Date
Undergrad Curicum Committee Date

North Central Department Head Date
North Central Chancellor Date
Date Approved by Graduate Council

Graduate Council Secretary Date

West Lafayette College/School Dean Date

Graduate Dean Date

West Lafayette Registrar Date

OFFICE OF THE REGISTRAR
TO: The Faculty of the School of Mechanical Engineering

FROM: Thomas Siegmund

DATE: April 15, 2016

RE: New Course, ME 65000 Computational Fracture Mechanics

The Faculty of the School of Mechanical Engineering has approved the following new course offering. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ME 65000 COMPUTATIONAL FRACTURE MECHANICS
Sem. 2. Class 3, cr. 3 (el.) (Offered in alternate years.)
Prerequisite: graduate student standing

Course Description: Advanced concepts of methods for the analysis of cracks, of crack propagation and damage evolution. Prediction of the macroscopic behavior of structures as it emerges from the presence of defects such as cracks, voids, or delamination. Linear elastic and nonlinear fracture problems. Rate independent and rate dependent problems. Methods in computational fracture mechanics where material separation emerges as an outcome of the boundary value problem. Demonstrations of how mechanical design can take advantage of the methods of computational fracture mechanics by introducing such concepts into structural analyses. Applications of computations in predictive analysis and its importance in simulation-based engineering.

Reason: This course has been offered several times on an experimental basis, each time with a substantive an enrollment both on campus and online via Engineering Professional Education. (Spring 2008: developed course, enrollment 14; Spring 2010: enrollment 13 on campus, and 6 on-line; Spring 2012: enrollment 15 on campus, and 13 on-line. Spring 2016: current enrollment 14). Many domains of mechanical, aerospace, civil and nuclear engineering require practicing engineers to be able to assess the risk to failure. Such assessment is invariably conducted with computational mechanics methods. If students do not acquire competency in this process, engineering solutions will continue to be based largely on traditional methods of tables and handbooks. These basic tools do not allow one to consider effects of material nonlinearity, and do also not consider complex loading scenarios. The performance of many engineering products is, however, increasingly linked to material nonlinearity and complex geometries. Only mechanical engineers with a sound background and training in the relevant engineering mechanics background will be able to handle these issues.

James D. Jones
Associate Professor and Associate Head, School of Mechanical Engineering
COMPUTATIONAL FRAC TURE MECHANICS
ME 65000

Course Outcomes
1. Introduce concepts of computational methods for material damage, fracture and fatigue
2. Learn continuum mechanics concepts for description of material failure
3. Learn advanced constitutive equations for bulk and interface fracture
4. Learn how to model material failure process
5. Learn how to develop and apply computational mechanics models
6. Apply these concepts to analysis of failure at macro, micro and nano scale

Fundamentals
1. Review of Continuum Mechanics
2. Review of Finite Element Mechanics Concepts
3. Frame Elastic-Plastic Forme
4. Displacement Fields
5. Crack Growth, Constraint
6. Load Scale
7. J-Integral
8. CTOD and CTOD
9. Stress Intensity Factors
10. Material Forces
11. Applications

Materials and Auxiliaries
1. Cohesive Zone Model
2. Cohesive Zone Models
3. Fatigue in Ceramics
4. Failure
5. Interfaces
6. Metal Matrix Composites
7. Nano Composites
8. MD Methodology
9. Advanced Composite Zone

Fatigue Crack Growth (4 Whs)
Cohesive Zone Models (4 Whs)
Ductile Fracture (4 Whs)
To: Purdue University Graduate Council  
From: Faculty Member: James Jones  
Department: Mechanical Engineering  
Campus: West Lafayette  
Date: 4/18/16  
Subject: Proposal for New Graduate Course-Documents Supporting Registrar's Form 40  
Contact information if questions arise  
Name: James Jones  
Phone Number: 765-494-5691  
E-mail: jonesjd@purdue.edu  
Course Number: ME 65000  
Campus Address: 585 Purdue Mall Room 2200  
Course Title: Computational Fracture Mechanics

A. Justification for the Course  
× Explain how this course relates to other courses offered in the department or other departments and how this course fulfills a recognized need.

× This course is intended primarily for students  
Choose one: from within this department

B. Level of the course:  
× Justify request for graduate course level by indicating anticipated enrollments of undergraduate and graduate students.
  Anticipated Undergraduate Student Enrollment: 0-10%
  Anticipated Graduate Student Enrollment: 75-100%

C. Prerequisites: (If none, please explain reasons for absence)

D. Course Instructor:
× Instructor's Name Thomas Siegmund

E1. Course Outline:
× (An outline of topics to be covered and an indication of the relative emphasis or time devoted to each topic is necessary. If laboratory or field experience is involved, the nature of this component should be explained as well).

E2. Method of Evaluation or Assessment:

F. Reading List:
× A reading list or bibliography should be limited to material the students will be required to read in order to successfully complete the course. It should not be a compilation of general reference material.